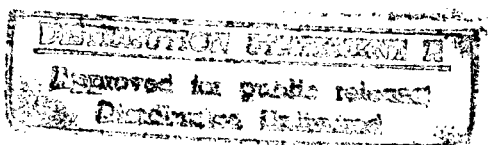


Basewide Energy Systems Plan

Executive Summary

Final Report



Fort Campbell, Kentucky

March 1983

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Prepared For
MOBILE DISTRICT CORPS OF ENGINEERS
MOBILE, ALABAMA
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EXECUTIVE SUMMARY - INCREMENTS A, B, C, D AND E

Included in this summary are the results of the Basewide Energy Systems Plan for Fort Campbell, Kentucky. This plan includes an analysis and recommendation of energy conservation projects for the reduction of the installation's present energy consumption. The savings figures presented in this summary can only be realized after all projects have been implemented. Black & Veatch has developed projects that would meet the funding requirements for the energy conservation program. Furthermore, the recommended projects provide partial compliance with the energy conservation requirement for the installation as outlined in the Army Facilities Energy Plan. This summary presents data on the following:

- Energy use model
- Existing energy consumption
- Source energy reductions due to energy conservation techniques applied to building systems
- Application of solar energy to reduce fossil fuel consumption
- Savings utilizing central energy monitoring and control systems (EMCS)
- Use of solid waste as an alternate energy source
- The analysis of Total Energy/Selective Energy (TE/SE) systems

Tables 1 and 2 located in the Appendix present information pertaining to the physical descriptions and energy consumption of 40 typical buildings used to verify historical energy consumption in the development of the basewide energy use model. This model was then utilized as

the foundation for energy conservation project analyses and recommendations. Table 3 in the Appendix summarizes the daily personnel occupancy for each typical building. Tables 1, 2 and 3 also provide information which was used to estimate source energy consumption for similar buildings within the designated groupings.

Table 4 in the Appendix indicates the annual source energy consumed by each of the building groups used in the basewide energy use model. Since Fort Campbell has experienced major expansion in its housing of families and troops, our model was compared to fiscal year 1978. This housing expansion has been incorporated into the building list. The estimated annual source energy consumption for all building groups calculated by the energy use model for base year 1978 was 4,160,264 mega-Btu per year. The energy use model was within 9 percent of the historical source energy consumption for FY 78 shown below.

Historical Source Energy
Consumption in Btu x 10⁶
for FY 78

Electricity	2,106,125
Natural Gas	1,311,034
Propane Gas	9,880
Fuel Oil No. 2	72,468
Fuel Oil No. 5	<u>288,228</u>
TOTAL	3,787,735

Figure 1 illustrates a percentage breakdown of the annual source energy consumption from Table 4.

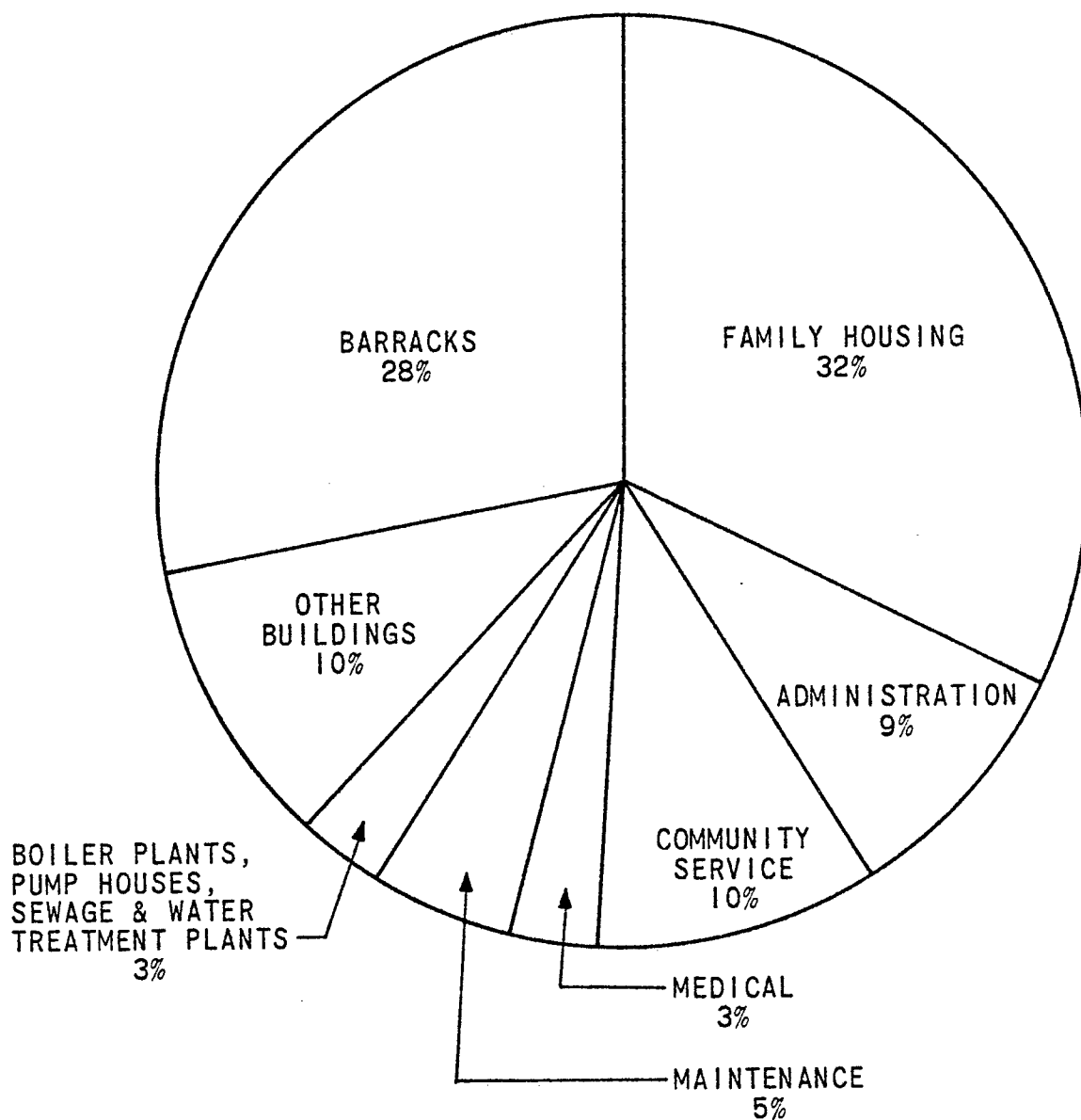


FIGURE 1
FORT CAMPBELL
BASEWIDE CONSUMPTION
(BASE YEAR 1978)

The total estimated source energy savings due to implementation of all feasible energy conservation projects developed within Increments A, B, C, D and E of this study is 634,812 mega-Btu per year. These projects consisted of various mechanical and electrical system modifications and are summarized in Tables 5 and 6 in the Appendix.

Table 5 lists the project number, percent of basewide reduction, and the source energy savings for the indicated building types. Figure 2 illustrates the combined effect of the recommended energy saving improvements, as compared to the FY 78 source energy expenditure. The estimates indicate a savings of approximately 17 percent over the base year (1978). Further explanation of the historical energy consumption, basewide energy use model, and energy conservation analysis can be found in the Energy Use Survey. Figure 3 illustrates the allocation of the energy conservation project savings for significant building groups.

Table 6 was developed to give a prioritized schedule, in order of fiscal year, for implementing the recommended energy conservation projects.

Utilizing solar energy, a renewable energy source, to reduce dependence on nonrenewable energy sources at Fort Campbell indicates a total savings of 17,176 mega-Btu per year. Nine concepts were evaluated, resulting in the recommendation of Project Nos. 418 and 421 which are presented in the report in Volume I entitled Solar Energy Applications and Evaluations.

The report on Energy Monitoring and Control Systems (EMCS) recommends the installation of a minicomputer-based EMCS center. This

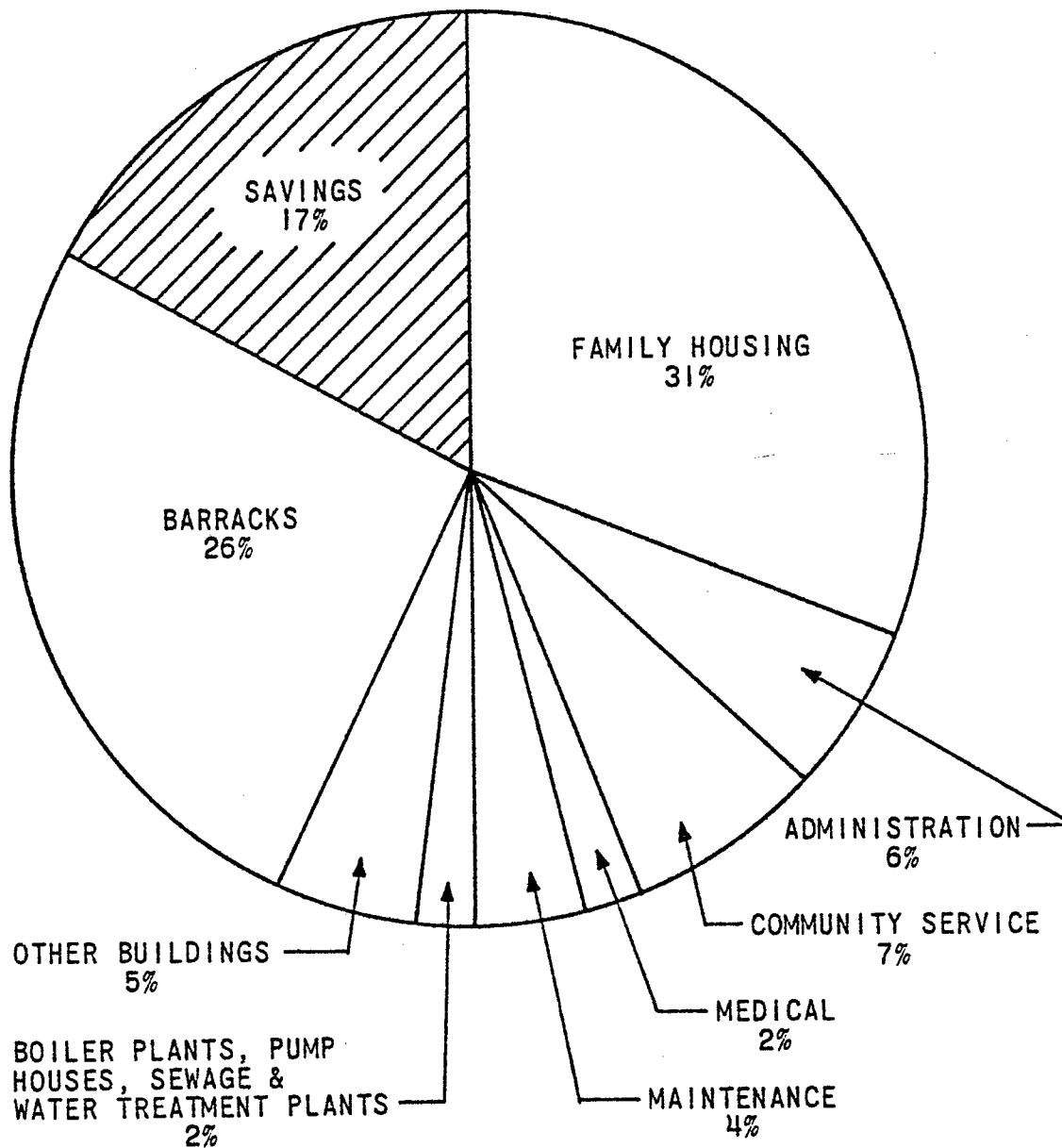
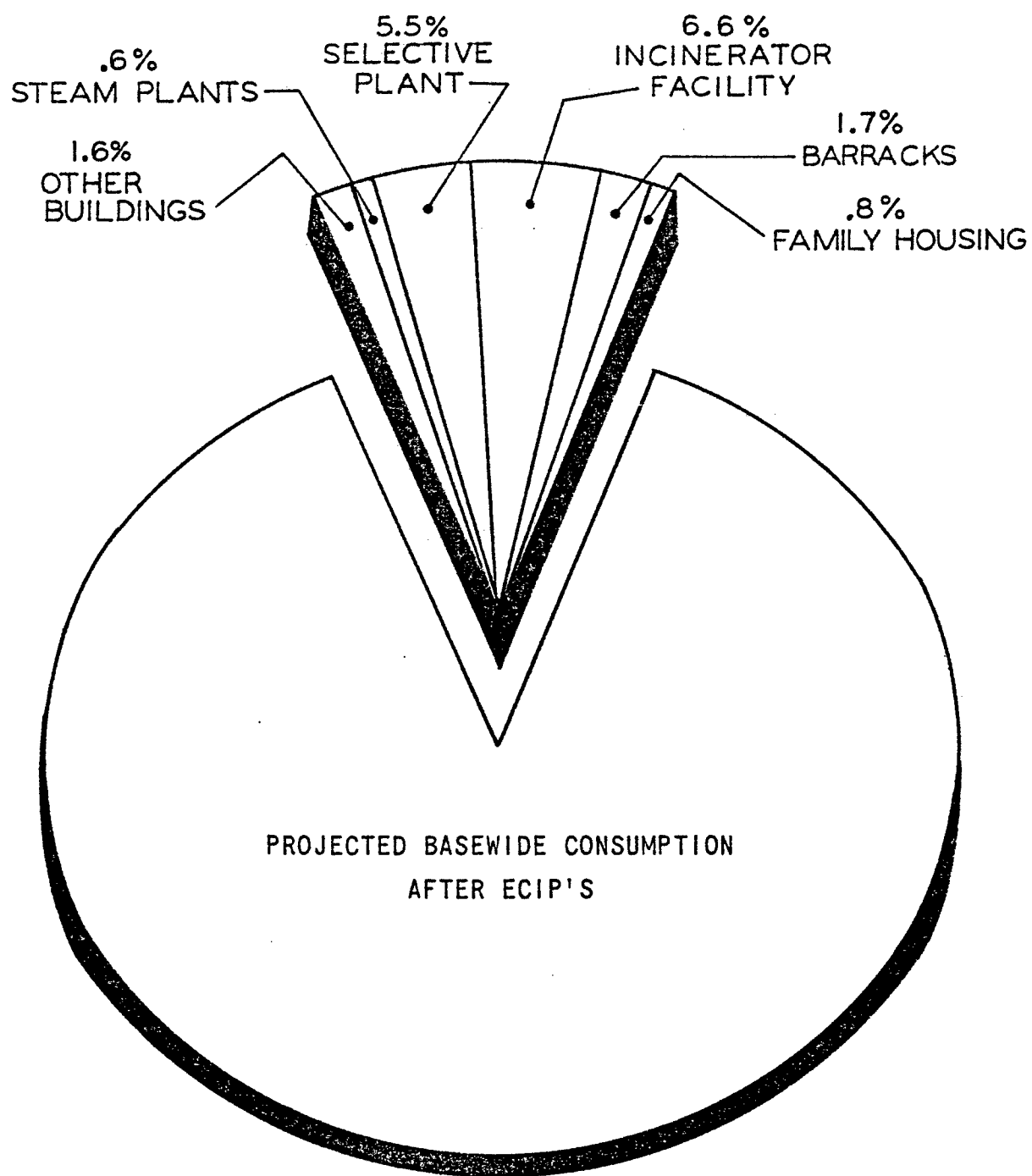


FIGURE 2
FORT CAMPBELL
BASEWIDE CONSUMPTION
AFTER
ENERGY CONSERVATION PROJECTS
(BASE YEAR 1978)



ALLOCATION OF
ENERGY CONSERVATION PROJECT'S
SAVINGS

FOR SIGNIFICANT BUILDING GROUPS

FIGURE 3 .

system, now scheduled for FY 84, would enable the installation to reduce its energy consumption by utilizing various computer initiated energy reducing applications programs. With the addition of an FM radio system under the control of the minicomputer, the entire EMCS project would save 132,718 mega-Btu per year. Additional information is provided in the EMCS report in Volume I.

The investigation of solid waste for reducing source energy consumption at Fort Campbell resulted in the development of Project No. 416. This project recommends the installation of two solid waste-burning incinerator facilities to provide steam to the existing steam distribution systems. The proposed plants would enable the installation to supplement the Central Energy Facility No. 3902 and Heating Plant No. 7008, thereby reducing fuel oil and electric consumption totalling 248,028 mega-Btu per year. This project is scheduled for FY 84. The details and descriptions of the systems analyzed can be found in the report, Total Energy, Selective Energy, and Central Boiler Plants in Volume I.

The installation of a coal-burning Selective Energy plant has been recommended for Fort Campbell and is scheduled for FY 85. This plant would supply steam to an expanded steam distribution system while generating 36 percent of the installation's total electric power requirements. A basewide source energy savings of 5 percent could be realized with a reduction of 45 percent in natural gas and fuel oil consumption. Detailed descriptions of the TE/SE systems analyzed are included in the Total Energy, Selective Energy, and Central Boiler Plants report in Volume I.

EXECUTIVE SUMMARY - INCREMENTS F AND G

This is a summary of the two phases of work, Increments F and G, that were completed in December, 1982.

The purpose of Increment F of the Basewide Energy Systems Plan is to identify and develop recommendations that can be used by Fort Campbell in preparing its energy management plan. Increment G identifies maintenance, repair and minor construction projects for the purpose of conserving energy. These are energy conservation projects that did not meet ECIP criteria or did not fit the ECIP program at the time that Increments A, B, C, D, and E of the study were completed.

The average costs of energy for FY 81 are given in Table 7 in the Appendix. These costs have been used as the basis for determining the dollar savings due to energy conservation.

Projects developed within the scope of Increments F and G are summarized in Table 8 and 9 respectively (See Appendix). Projects are prioritized by their E/C ratio. The E/C ratio is defined as the ratio of yearly energy savings in million Btu to the cost estimate in thousands of dollars. Any project showing a payback of 15 years or less and a Benefit-to-Cost ratio (B/C) greater than 1.0 is recommended. Material and labor cost estimates are representative of April, 1981 prices.

Nine projects were put into 1391 format to be submitted by Fort Campbell for possible ECIP funding.

The first project, Automatic Chiller Tube Cleaning, involves installing an automatic cleaning system in the condenser to increase heat transfer.

The next two projects were combined into one 1391 entitled Heating Upgrade. One project, Boiler Replacement, involves replacing old boilers at 10 buildings with smaller more efficient models. The other project, Thermostatic Steam Valves, involves installing thermostatic control valves where manual ones are now.

Four projects involve work in Family Housing and these were combined into one 1391 entitled, Family Housing Energy Conservation. The project Receptacle Insulation calls for the installation of foam gaskets behind the plates of all receptacles and wall switches. Another insulation project, Insulate Water Heaters, involves the installation of 2 inches of additional insulation to exterior of all water heaters. The third project, Reduce Infiltration in Family Housing, involves caulking the soleplate and other cracks in all structures. The fourth Family Housing project, Furnace Derating, would decrease the rating of each furnace to more efficiently meet the load requirement.

The fourth 1391 is entitled FM Control System Expansion. This project involves expansion of the FM Control System to all buildings where setback is possible.

The fifth 1391 developed was Boiler Fuel Conservation/Oxygen Trim Control. This project evaluated the need to optimize the performance of the boilers at five boiler plants.

The ECIP documentation for these projects appears in Appendix B of Volume VI.

The total estimated source energy savings due to implementation of all the recommended projects in Increment F is 285,850 mega-Btu per year. The total estimated savings due to implementation of all recommended projects in Increment G is 395,300 mega-Btu per year.

CONCLUSION

The projected future energy savings at Fort Campbell due to the scheduled ECIP projects developed under Increments A, B, C, D, and E, construction of the Solid Waste Incinerator Facility, Selective Energy Plant, installation of the EMCS system, and recommended projects from Increments F and G is shown in Figure 4. The scheduled ECIP projects section includes these projects: Steam Plant Modifications (P/N 301), Remove Existing Windows and Replace with Insulated Panels and Glass (P/N 287), and Insulate Hot Water Lines at USAH (P/N 288).

Figure 5 represents a forecast of future energy costs at Fort Campbell. The graph compares how costs could escalate if no energy conservation projects are implemented versus energy costs if all cost effective projects are implemented. The energy conservation projects are assumed to be implemented in the following three phases:

Phase I - Scheduled ECIP Projects

Phase II - Solid Waste Incinerator Facility and EMCS System

Phase III - Increments F and G projects and Selective Energy Plant

Figure 5 does not account for new building construction.

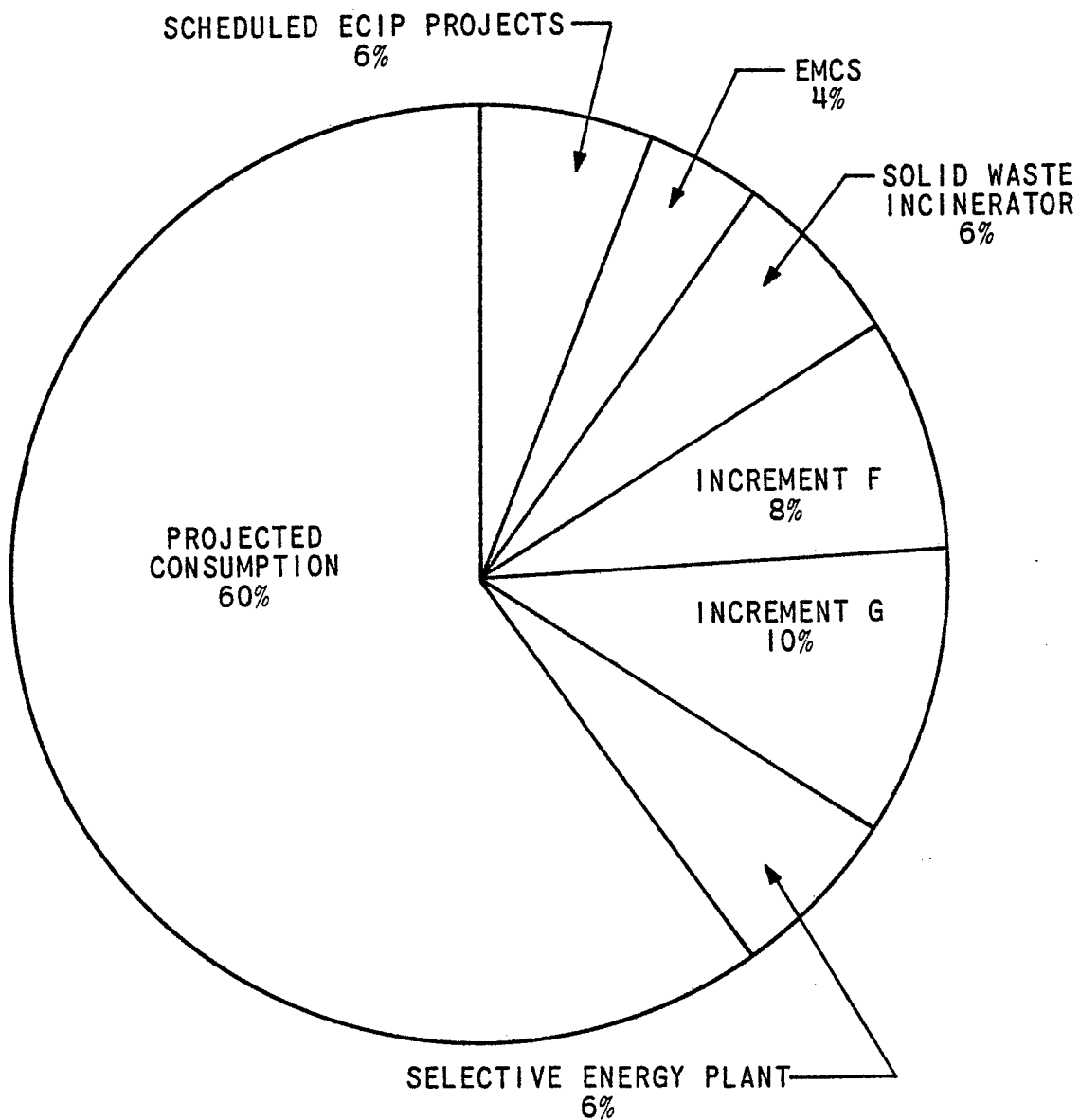
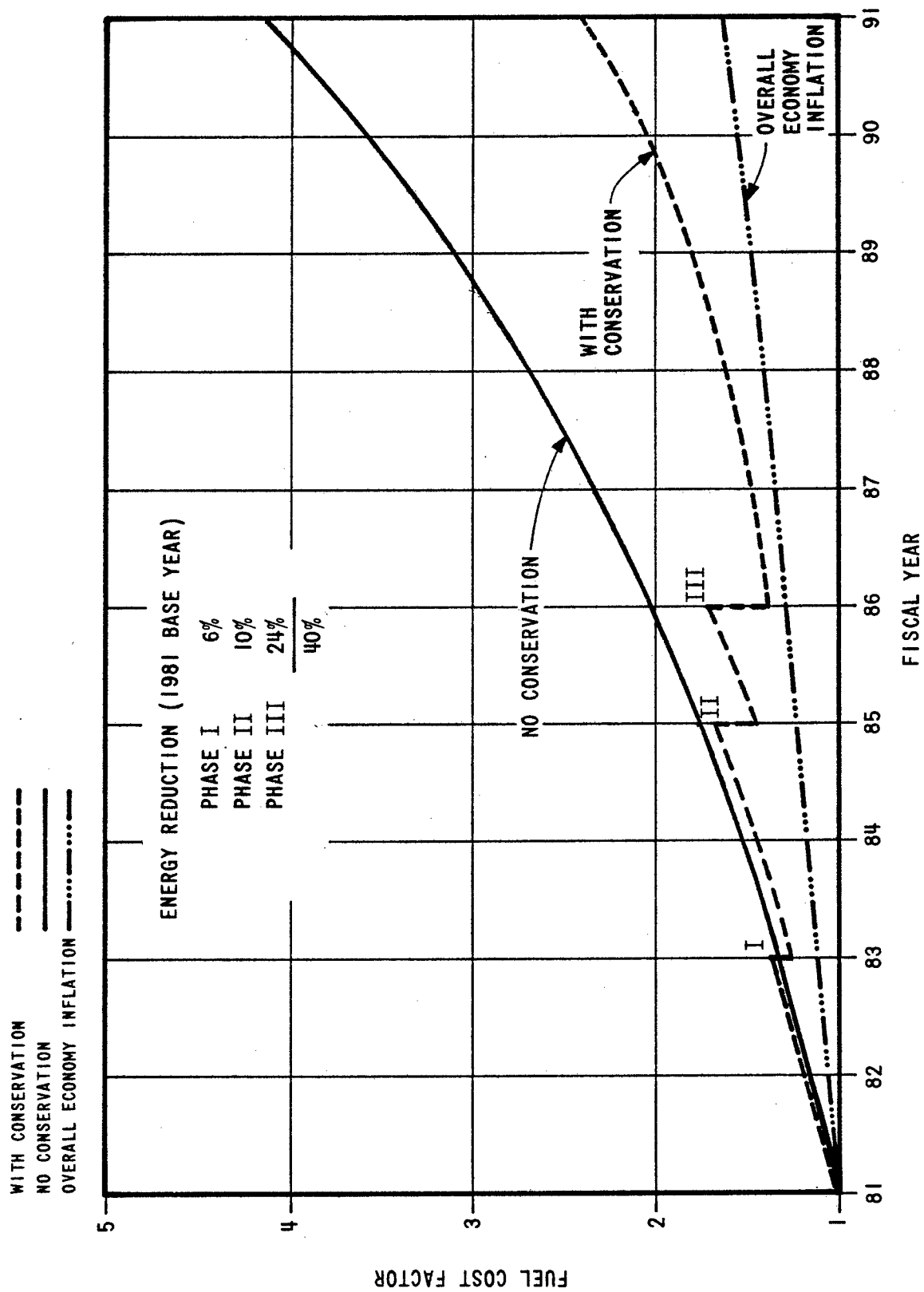


FIGURE 4
FORT CAMPBELL
BASEWIDE CONSUMPTION
(BASE YEAR 1981)

FIGURE 5
FORT CAMPBELL
EFFECT OF ESCALATION AND ENERGY
CONSERVATION ON FUEL COST



APPENDIX

TABLES

TABLE 1
TYPICAL BUILDING CONSTRUCTION DATA
FORT CAMPBELL

GROUP NO.	BLDG.	BUILDING DESCRIPTION	NO. FLS.	CONSTRUCTION				"U" VALUES						WINDOM SQ. FT.	AREA (FT. ²)	COOLING		HEATING		PEAK TRNS LOAD TONS		DOMESTIC HOT WATER CAP. (G)	
				ROOF	WALL	FLOOR	WINDOW	DOOR	ROOF	WALL	FLOOR	WINDOW	DOOR			SYSTEM	CAP. (TONS)	SYSTEM	FUEL	GAIN	LOSS		
A-1	6918	OFFICE	1	BUILT-UP	CNU	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.07	.36	—	1.13 1.06	.55	1142	3660	WINDOM UNITS	3	B.P. 7008	HOT H ₂ O	59.1487.2	30	ELEC.	
A-2	5115	MOTOR REPAIR OFFICE	1	BUILT-UP	ASBESTOS WOOD FRAME	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD	.85	.31	—	1.13 1.06	.49	177	3072	WINDOM UNITS	3	UNIT HTRS.	GAS	13.8188.8	42	ELEC.	
A-3	7258	OFFICE	2	BUILT-UP	CNU	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.06	.47	—	1.13 1.06	.55	599	6560	SPLIT SYSTEM	20	HOT H ₂ O BOILER	GAS	52.4144.2	20	ELEC.	
B-1	6709	BARACKS WITH MESS	2	BUILT-UP	CNU	TILE, CLOSED CRANL SPACE	SINGLE CLEAR GLASS	WOOD	.06	.13	.58	1.13 1.06	.49	5843	39722	ABSORPT. CHILLER	80	B.P. 6711	STEAM	156.4681.6	950	STEAM	
B-2	7120	BARACKS	3	BUILT-UP	CMC. BLOCK	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.14	.37	—	1.13 1.06	.55	2712	25200	PKG.	46	B.P. 7106	STEAM	143.9377.1	575	STEAM	
B-3	1582	RECHERCH OFFICER'S QTRS.	2	ASPHALT SHINGLES	WOOD SIDING & STUCCO	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD	.05	.06	—	1.13 1.06	.49	1008	8740	SPLIT SYSTEM	17	FURNACE	GAS/OIL	31.2113.7	100	GAS/OIL	
B-4	2170	BARACKS	2	COMPOSITE SHINGLES	CLAPBOARD WOOD FRAME	TILE, OPEN CRANL SPACE	SINGLE CLEAR GLASS	WOOD	.32	.32	.46	1.13 1.06	.47	408	5310	—	—	FURNACE	GAS	—	206.5	100	GAS
C-1	6990	GYMNASIUM	1	BUILT-UP	CNU	SLAB ON GRADE	SINGLE CLEAR GLASS	GLASS, METAL	.07	.51	—	1.13 1.06	.55	1896	23229	PKG. & SPLIT SYSTEM	26	BOILER	GAS	90.5608.7	250	GAS	
C-2	3109	THEATER	1	COMPOSITE SHINGLES	CLAPBOARD WOOD FRAME	TILE, OPEN CRANL SPACE	SINGLE CLEAR GLASS	METAL	.32	.32	.46	1.13 1.06	.55	431	4553	SPLIT SYSTEM	13	FURNACE	GAS	104.7294.9	—	—	
C-3	2607	CHAPEL	1	ASPHALT SHINGLES	CLAPBOARD WOOD FRAME	T & G, CLOSED CRANL SPACE	SINGLE CLEAR GLASS	WOOD	.34	.26	.19	1.13 1.06	.47	503	3765	—	—	UNIT HTR. RADIATOR	GAS	—	128.5	10	GAS
C-4	5702	PRATT MUSEUM	2	BUILT-UP	METAL SIDING	SLAB ON GRADE	—	METAL	.07	.06	—	—	—	—	18000	WATER COOLED	90	HOT H ₂ O BOILER	GAS	35.1127.8	80	ELEC.	
C-5	6722	POST EXCHANGE	1	BUILT-UP	CMC. BLOCK	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.18	.53	—	1.13 1.06	.55	491	5867	WATER COOLED	15	BOILER	GAS	35.7160.5	140	STEAM	
C-6	2675	FIRE STATION	1	BUILT-UP	CNU	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.13	.31	—	1.13 1.06	.55	719	7557	WIN. U. & PKG.	9	BOILER	GAS	30.1163.5	80	ELEC.	
D-1	2440	MCO MESS	1	COMPOSITE SHINGLES	CLAPBOARD WOOD FRAME	TILE, CLOSED CRANL SPACE	SINGLE CLEAR GLASS	WOOD	.05	.32	.38	1.13 1.06	.47	370	2200	—	—	UNIT HTRS.	GAS	—	66.1	100	GAS
E-1	2442	CLASSROOM	1	COMPOSITE SHINGLES	CLAPBOARD WOOD FRAME	TILE, CLOSED CRANL SPACE	SINGLE CLEAR GLASS	WOOD	.05	.32	.38	1.13 1.06	.47	370	2200	—	—	UNIT HTRS.	GAS	—	75.5	100	GAS
E-2	2912	CLASSROOM	1	METAL	—	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.15	.27	—	1.13 1.06	.55	27	3500	—	—	FURNACE	GAS	—	95.3	30	GAS
F-1	4364	DUPLEX FAMILY HOUSING	2	ASPHALT SHINGLES	BRICK & ALUMINUM	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD	.06	.08	—	1.13 1.06	.49	386	3900	HEAT PUMPS	283	HEAT PUMPS	ELEC.	14.6	53.0	40	ELEC.
F-2	402	DUPLEX FAMILY HOUSING	1	ASPHALT SHINGLES	BRICK & ALUMINUM	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD	.06	.17	—	1.13 1.06	.49	226	2684	PKG.	243	FURNACE	GAS	21.9	56.1	40	GAS
F-3	4848	MULTI-FAMILY HOUSING	2	ASPHALT SHINGLES	BRICK WOOD FRAME	T & G, CLOSED CRANL SPACE	SINGLE CLEAR GLASS	WOOD	.06	.22	.30	1.13 1.06	.47	1428	11304	WINDOM UNIT	1	UNIT HTR.	ELEC.	22.2220.7	40	ELEC.	
F-4	465	SINGLE FAMILY HOUSING	1	ASPHALT SHINGLES	BRICK, WOOD FRAME	OAK, CLOSED CRANL SPACE	SINGLE CLEAR GLASS	WOOD	.06	.08	.20	1.13 1.06	.47	307	1584	WINDOM UNIT	1	CENTRAL HTR.	GAS	4.3	36.6	80	ELEC.
F-5	3027	MULTI-FAMILY HOUSING	2	BUILT-UP	BRICK & SHEATHING	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD	.07	.08	—	1.13 1.06	.47	1633	10296	WINDOM UNIT	1	CENTRAL HTR.	GAS	18.1177.1	40	ELEC.	
F-6	7370	MULTI-FAMILY HOUSING	2	BUILT-UP	BRICK & WOOD SIDING	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD	.06	.20	—	1.13 1.06	.47	1867	10496	REMOTE AIR COOLED UNIT	26	CENTRAL HTR.	GAS	59.9200.7	40	ELEC.	
L-1	860	LAUNDRY	1	ASPHALT SHINGLES	CLAPBOARD WOOD FRAME	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD	.33	.26	—	1.13 1.06	.47	36	5558	WINDOM UNIT	1.5	—	—	9.59	—	8/A	—
M-1	125	HOSPITAL	2	ASPHALT SHINGLES	BRICK	T & G, CRANL SPACE	SINGLE CLEAR GLASS	WOOD	.33	.26	.30	1.13 1.06	.47	3246	16768	CENTRAL & WIN.	28	B.P. 157	STEAM	867.4524.4	200	GAS	
M-2	127	HOSPITAL	2	ASPHALT SHINGLES	BRICK	T & G, CRANL SPACE	SINGLE CLEAR GLASS	WOOD	.33	.26	.30	1.13 1.06	.47	3246	16768	—	—	B.P. 157	STEAM	—	395.0	200	GAS
M-P	7297	HELICOPTER HANGER	2	BUILT-UP	CNU, METAL	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.18	.51	—	1.13 1.06	.55	400	48564	WINDOM UNIT	30	B.P. 7294	STEAM	47.0448.5	100	ELEC.	
P-1	749	MOTOR REPAIR	1	MINERAL SURFACE	CLAPBOARD, WOOD FRAME	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.32	.36	—	1.13 1.06	.47	456	3108	—	—	BOILER	COAL	—	157.5	40	ELEC.
RN-1	6256	MOTOR REPAIR SHOP	1	BUILT-UP	CONCRETE	SLAB ON GRADE	SINGLE CLEAR GLASS	METAL	.13	.67	—	1.13 1.06	.55	1326	4960	—	—	B.P. 6256	GAS	—	192.0	40	GAS
RN-2	2852	REPAIR & MAINTENANCE	1	MINERAL SURFACE	CLAPBOARD T & G SIDING	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD	.32	.36	—	1.13 1.06	.47	48	2312	—	—	BOILER	COAL	—	35.9	40	GAS

TABLE 1 (CONT'D)

[illegible]

TABLE 2
TYPICAL BUILDING ENERGY CONSUMPTION DATA
FORT CAMPBELL

GROUP NO.	BLDG.	BUILDING DESCRIPTION	ANNUAL ENER. SOURCE CONSUMPTION BTU x 10 ⁶			ELEC'L ENER. CONSUMPTION		BTU x 10 ³ FT ²
			FUEL	ELEC.	TOTAL	KW PEAK	KWH/YR	
A-1	6914	OFFICE	868	415	1283	36	35750	350.5
A-2	5115	MOTOR REPAIR OFFICE	630	265	895	16	22860	291.3
A-3	7258	OFFICE	669	1850	2519	72	159490	384.0
B-1	6709	BARRACKS WITH MESS	10101	4675	14776	94	403048	372.0
B-2	7120	BARRACKS	2704	5423	8127	160	467481	322.5
B-3	1582	BACHELOR OFFICER'S QTRS.	1032	1873	2905	48	161460	332.4
B-4	2170	BARRACKS	1347	66	1413	2	5660	266.1
C-1	6990	GYMNASIUM	3953	2540	6493	97	218930	279.5
C-2	3109	THEATER	1137	401	1538	52	34560	337.1
C-3	2607	CHAPEL	513	384	897	12	33130	238.2
C-4	5702	PRATT MUSEUM	1768	907	2675	79	78160	191.1
C-5	6722	POST EXCHANGE	972	1947	2919	67	167840	754.8
C-6	2575	FIRE STATION	918	947	1865	34	81610	246.8
D-1	2440	NCO MESS	625	134	759	3	11570	345.0
E-1	2442	CLASSROOM	514	147	661	6	12670	300.5
E-2	2912	CLASSROOM	441	325	766	11	27990	218.9
F-1	4364	DUPLEX FAMILY HOUSING	0	787	787	33	67870	201.8
F-2	402	DUPLEX FAMILY HOUSING	417	197	614	11	16990	228.8
F-3	4848	MULTI-FAMILY HOUSING	0	4444	4444	145	383130	393.1
F-4	465	SINGLE FAMILY HOUSING	210	266	476	10	22900	300.5
F-5	3027	MULTI-FAMILY HOUSING	795	2061	2856	69	177700	277.4
F-6	7370	MULTI-FAMILY HOUSING	916	2316	3232	144	199680	307.9
L-1	860	LAUNDRY	66960	13227	80187	264	1140240	1443.3
M-1	125	HOSPITAL	3665	2163	5828	112	186460	347.6
MP-1	127	HOSPITAL	5400	1482	6882	18	127820	410.4
M-P	7297	HELICOPTER HANGER	1239	7971	9210	323	687160	189.6
P-1	749	MOTOR REPAIR	238	212	450	9	18250	144.8
RM-1	6256	MOTOR REPAIR SHOP	249	441	690	17	38030	139.1
RM-2	5852	REPAIR & MAINTENANCE	282	34	316	1	2960	136.7

TABLE 2 (CONT'D)
TYPICAL BUILDING ENERGY CONSUMPTION DATA
FORT CAMPBELL

[illegible]

TABLE 3
BUILDING OCCUPANCY
FORT CAMPBELL

GROUP NO.	BLDG.	BUILDING DESCRIPTION	NORMAL PEAK POPULATION	OCCUPANCY
A-1	6914	OFFICE	20	WEEKDAYS - 6:30 A.M. TO 6:00 P.M.; 3 PEOPLE AT NIGHT
A-2	5115	MOTOR REPAIR OFFICE	11	WEEKDAYS - 7:30 A.M. TO 4:00 P.M.
A-3	7258	OFFICE	35	OPEN 24 HOURS - 35 PEOPLE FROM 7:00 A.M. TO 6:00 P.M.; 2 PEOPLE AT NIGHT
B-1	6709	BARRACKS WITH MESS	333	BARRACKS OPEN 24 HOURS MESS OPEN 6:30 A.M. TO 8:00 P.M.; KITCHEN PERSONNEL START AT 4:00 A.M.
B-2	7120	BARRACKS	144	OPEN 24 HOURS
B-3	1582	BACHELOR OFFICERS' QTRS.	24	OPEN 24 HOURS
B-4	2170	BARRACKS	28	OPEN 24 HOURS
C-1	6990	GYMNASIUM	1000	WEEKDAYS - 9:00 A.M. TO 9:00 P.M. WEEKENDS - 12:00 NOON TO 9:00 P.M.
C-2	3109	THEATER	176	WEEKDAYS - 1:00 P.M. TO 10:00 P.M. OCCASIONALLY ON WEEKENDS
C-3	2607	CHAPEL	300	7 DAYS A WEEK, 5 PERSONS AVERAGE, 7:00 A.M. TO 10:00 P.M.; TUESDAY & THURSDAY - 40 PERSONS IN EVENING; SUNDAY - 300 PERSONS, 9:45 A.M. TO 12:00 NOON
C-4	5702	PRATT MUSEUM	25	WEEKDAYS - 12:30 P.M. TO 4:30 P.M. WEEKENDS - 1:00 P.M. TO 4:30 P.M.
C-5	6722	POST EXCHANGE	100	WEEKDAYS - 11:00 A.M. TO 6:00 P.M.
C-6	2575	FIRE STATION	12	OPEN 24 HOURS
D-1	2440	NCO MESS	80	WEEKDAYS - 5:00 A.M. TO 7:00 P.M.
E-1	2442	CLASSROOM	100	WEEKDAYS - 7:00 A.M. TO 6:00 P.M.
E-2	2912	CLASSROOM	125	TUESDAY TO FRIDAY - 8:00 A.M. TO 11:30 A.M.
F-1	4364	DUPLEX FAMILY HOUSING	8	OPEN 24 HOURS
F-2	402	DUPLEX FAMILY HOUSING	8	OPEN 24 HOURS
F-3	4848	FAMILY HOUSING	48	OPEN 24 HOURS
F-4	465	FAMILY HOUSING	4	OPEN 24 HOURS
F-5	3027	FAMILY HOUSING	32	OPEN 24 HOURS
F-6	7370	MULTI-FAMILY HOUSING	32	OPEN 24 HOURS
L-1	860	LAUNDRY	112	WEEKDAYS - 7:00 A.M. TO 3:00 P.M.
M-1	125	HOSPITAL	120	OPEN 24 HOURS
M-2	127	HOSPITAL	120	OPEN 24 HOURS
MP	7297	HELICOPTER HANGER	150	WEEKDAYS - 7:00 A.M. TO 6:00 P.M.
P-1	749	MOTOR REPAIR	10	WEEKDAYS - 7:30 A.M. TO 4:00 P.M.
RM-1	6256	MOTOR REPAIR SHOP	30	WEEKDAYS - 7:30 A.M. TO 4:30 P.M.
RM-2	5852	REPAIR & MAINTENANCE	25	WEEKDAYS - 6:00 A.M. TO 4:30 P.M.
T-1	7851	RECEIVER BUILDING	4	OPEN 24 HOURS
T-2	7238	COMMUNICATION	5	OPEN 24 HOURS - 5 PERSONS FROM 7:00 A.M. TO 4:00 P.M., 2 PERSONS FROM 4:00 P.M. TO 7:00 A.M.
W-1	806	WAREHOUSE	10	WEEKDAYS - 8:00 A.M. TO 3:30 P.M.
W-2	854	WAREHOUSE	N/A	ONLY WHEN SOMETHING IS BEING STORED OR REMOVED
W-3	160	MEDICAL WAREHOUSE	21	WEEKDAYS - 7:30 A.M. TO 4:30 P.M.
L-2	2842	PRESSING PLANT	45	7 DAYS A WEEK - 7:00 A.M. TO 5:00 P.M.
U-1	7635	SEWAGE TREATMENT	2	OPEN 24 HOURS - 7 DAYS A WEEK
U-2	1746	WATER TREATMENT	10	OPEN 24 HOURS - 7 DAYS A WEEK

TABLE 3 (CONT'D)
BUILDING OCCUPANCY
FORT CAMPBELL

[illegible]

TABLE 4

Building Group Source Energy Consumption

<u>Group</u>	<u>Description</u>	<u>Group Sq. Ft.</u>	<u>Total Source Consumption⁶ Btu's x 10⁶</u>
A	Administrative	1,137,775	349,534
B	Barracks	3,967,825	1,179,135
C	Community Service	1,135,297	404,776
D	Dining	92,649	31,228
E	Classroom	190,965	51,915
F	Family Housing	5,718,653	1,328,611
L	Laundry	91,078	82,855
MP	Maintenance and Production	464,460	76,588
M	Medical	352,066	128,149
P	Maintenance	219,531	29,816
RM	Maintenance and Repair	716,075	94,704
T	Communications	53,730	33,912
U-1	Sewage Treatment	1,371	5,899
U-2	Water Treatment	10,276	91,068
U-3	Pump Houses	4,663	26,134
U-4	Boiler Plants	18,183	1,689
U-5	Unheated Buildings w/Electricity	18,980	6,018
W	Warehouses	931,999	140,479
Z	Electric Only (includes outdoor lights)	496,999	<u>97,754</u> 4,160,264

TABLE 5
ENERGY CONSERVATION PROJECTS
SOURCE ENERGY SAVINGS

BUILDING TYPE	ENERGY SAVINGS BTU x 1,000,000	% BASEWIDE REDUCTION FY 78	PROJECT NO.
FAMILY HOUSING	15,600 <u>12,738</u> 28,338	.41 <u>.34</u> .75	T-418 288
BARRACKS	65,180	1.72	288
INCINERATOR FACILITY	248,028	6.55	302
STEAM PLANTS	24,159	.64	301
SELECTIVE ENERGY PLANT	208,000	5.49	T-478
OTHER BUILDINGS AFFECTED BY ECIP'S	1,576 54,800 <u>4,731</u> 61,107	.04 1.45 <u>.12</u> 1.61	T-421 288 T-398
TOTAL	634,812	16.76	

TABLE 6

ENERGY CONSERVATION PROJECTS DEVELOPED SCHEDULE - FT. CAMPBELL, KENTUCKY

PROJECT TITLE	PROJECT NUMBER	RECOMMENDED FISCAL YEAR	COST \$ x 1000	E/C RATIO	ENERGY SAVINGS BTU x 1000,000	YEARS PAYBACK	B/C RATIO
POWER FACTOR IMPROVEMENT (BASEWIDE)	T-398	1981	136	34.87	4,731	13.6	1.26
TOTAL			136		4,731		
SOLID WASTE BURNING INCINERATOR FACILITIES	302	1982	7,324	33.9	248,028	12.4	2.09
SUPPLEMENTAL SOLAR DOMESTIC HOT WATER SYSTEMS	T-418	1982	645	24.2	15,600	15.3	1.10
STEAM PLANT MODIFICATIONS	301	1982	501	48.3	24,159	6.1	3.3
SOLAR HEATING OF INDOOR SWIMMING POOL AND SHOWER WATER	T-421	1982	80	19.6	1,576	9.9	1.91
ENERGY MONITORING AND CONTROL SYSTEM	288	1982	2,825	46.97	132,718	14.72	1.07
TOTAL			11,670		422,081		
SELECTIVE ENERGY PLANT	T-478	1983	72,050	N/A	208,000	17.83	1.33
TOTAL					208,000		

TABLE 7

Fort Campbell

Energy Costs

FY 81 Average

Electricity

Demand	\$ 6.40/kW
kWh (without demand)	0.0253/kWh
kWh (including demand)	0.0363/kWh

Natural Gas

Demand	\$ 2.02/mcf
Commodity (without demand)	2.53/mcf
Commodity (including demand)	2.89/mcf

Propane

Commodity	\$ 0.68/gal
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Fuel Oil

No. 2	\$ 1.22/gal
No. 5	1.05/gal

TABLE 8
Summary of Increment F Projects

Project	Location(s)	Energy Savings/Year MMBtu	Dollar Savings/Year	Payback Years	E/C	B/C	Contract Cost	Reference In-House Cost		Pages Narr. Calcs.
								Material	Manhours	
Reduction of Ventilation Air Quantities	83 Buildings	105,202	427,631	.02	14,901	1,655	7,060	1,434	Sheet Metal 450	10 A10
Covering Wind Turbines and Ventilators	Per Unit	36	141	.03	9,468	1,146	4.00	0.30	Laborer .33	A167
Flow Control Showerheads	Per Unit	37	169	.09	2,429	27	15	7	Laborer .5	A47
Lower Domestic Hot Water Temperature	67 Buildings	523	5,764	.05	1,659	439	315	0	Laborer 32	A203
✓ Furnace Derating	Family Housing	8,886	35,811	0.2	1,406	168	6,320	0	Heat 390	A249
Boiler Control	Bldg. 2604	(3) 166	(2) 669	(1) 0.2	(6) 1,297	(5) 157	(4) 128	57	Heat/Cool 2	A179
Clean Air Cooled Condensing Units	Per Unit	6.9	29	0.2	1,047	92	7.00	0	Laborer 1	A186
Turn Off Furnace Pilot Lights	Family Housing	4,997	17,639	0.3	925	94	5,400	0	Laborer 567	A231
Swimming Pool Cover	Bldg. 2193	1,201	4,844	0.3	829	100	1,449	1,380	Carpenter 12	A142
Cycle Pool Pumps	5 Bldgs.	573	2,372	0.4	680	60	843	412	Electrician 7	A173
Disconnect Outside Air	Bldg. 1430	36	145	0.4	667	85	54	10	Sheet Metal 2	A258
Pipe Insulation	Bldg. 2270	162	656	0.4	640	77	253	130	Insulator 3.5	A243
Turn Off Sump Heater	1296 Units Family Housing	2,179	6,276	0.8	443	19	4,922	0	Laborer 648	A216
		3	2	1	6	5	4			

TABLE 8
(Cont.)
Summary of Increment F Projects

Project	Location(s)	Energy Savings/Year MMBtu	Dollar Savings/Year	Payback Years	E/C	B/C	Contract Cost	Reference In-House Cost		Pages Narr. Calcs.
								Material	Manhours	
Turn Off Hot Water	Classrooms, Offices and Maint.	24,757 3	101,830 2	0.8 1	316 6	34 5	78,424 4	0	Plumber 2,488	46 A297
Receptacle Insulation	All Family Housing	10,012	33,164	1.0	291	24	34,464	6,241	Laborer 2,786	25 A134
Filter Maintenance	Family Housing	27,853	115,311	0.9	286	17	97,415	14,572	Laborer 8,306	45 A288
Weatherstrip Doors	5 Buildings	154	612	0.9	280	31	552	201	Laborer 8	32 A190
Duct Insulation in Unconditioned	Bldg. 6550	220	1,978	.50	239	50	917	515	Carpenter 9	8 A1
Insulate Water Heaters	28 Units (Per Unit Postwide)	35	142	1.5	164	19	213	142	Laborer 14	20 A102
Relamping Barracks Hallways	57 Buildings	4,607	29,591	1.1	151	16	30,554	14,364	Electrician 100	44 A278
Insulate Water Heaters	4153 Family Housing Units	6,588	21,975	2.4	127	11	51,855	20,247	Laborer 2,077	20 A102
Replacement of Electric Water Heaters	Bldg. 1492	134	336	3.6	111	4	1,204	724	Plumber 8	42 A265
Heat Recovery From Dust Collector	Bldg. 5613	306	1,080	2.7	106	11	2,900	1,500	Sheet Metal 10	13 A54
Reduce Infiltration in Family Housing	All Family Housing	41,685 3	135,909 .2	3.7 1	82 6	7 5	509,500 4	290,535	Laborer 12,459	21 A118

TABLE 8
(Cont.)
Summary of Increment F Projects

Project	Location(s)	Energy Savings/Year MMBtu	Dollar Savings/Year	Payback Years	E/C	B/C	Contract Cost	Reference		Pages Narr. Calcs.
								Material	In-House Cost Manhours	
Solar Film (West)	Per Sq. Ft.	.1284	0.54	3.5	68	5	4	-	-	18 A94
Solar Film (Southwest)	Per Sq. Ft.	.1214	0.50	3.8	65	6	1.79	-	-	18 A94
Solar Film (East)	Per Sq. Ft.	.1189	0.50	3.8	63	6	1.79	-	-	18 A94
Solar Film (Southeast)	Per Sq. Ft.	.1130	0.47	4.0	60	5	1.79	-	-	18 A94
Building Insulation and Weatherstrip Doors	Bldg. 2604	1,724	6,952	4.6	54	7	32,000	10,500	Laborer 3,597	36 A222
Garage Door Weatherstripping	9 Buildings	962	3,771	4.8	53	6	18,154	8,100	Laborer 256	38 A236
Window Insulation	12 Buildings	1,528	6,158	4.8	52	6	29,700	12,550	Laborer 6,670	15 A60
Solar Film (Northwest)	Per Sq. Ft.	.0934	0.39	4.8	50	5	1.79	-	-	18 A94
Solar Film (Northeast)	Per Sq. Ft.	.0894	0.37	5.1	48	5	1.79	-	-	18 A94
Solar Film (South)	Per Sq. Ft.	.0881	0.36	5.2	47	4	1.79	-	-	33 A94
Calking	2 Buildings	33	129	6.1	42	5	792	261	Laborer 39	33 A197
Cleaning of Air Handling Unit Coils	Per Unit	17	72	6.4	38	3	462	58	Sheet Metal 16	23 A125
Solar Film (North)	Per Sq. Ft.	.0550	0.23	8.2	29	3	1.79	-	-	18 A94
Insulated Panels	65 Buildings	14,386	58,420	9.4	26	3	548,659	335,214	Carpenter 18,312	17 A67

7 2 1 6 5 4

TABLE 9

Summary of Increment G Projects

Project	Location (s)	Energy Savings/Year MMBtu	Dollar Savings/Year	Payback Years	E/C	B/C	Contract Cost	In-House Cost		Reference Pages	
								Material	Manhours	Narr.	Calcs.
Insulating Buildings	5123 & 5125	22,254	\$ 89,728	0.1	1,755	213	\$ 12,681	\$ 4,631	Laborer - 250	41	B-306
Insulating Buildings	7 Bldgs.	117,873	475,264	0.3	979	119	120,341	87,861	Laborer - 4754	41	B-298
Automatic Chiller Condenser Tube Cleaning	Bldg. 6726 and 4 other bldgs.	53,778	216,833	1.1	252	31	213,373	101,606	Heat/Cool Mech. - 8645	12	B-86
Automatic Chiller Condenser Tube Cleaning	New Hospital	11,562	47,867	1.2	209	18	55,319	35,123	Heat/Cool Mech. - 1494	12	B-98
FMI Control System Expansion	331 Bldgs.	83,654	366,752	1.3	171	22	490,135	174,159	Electrician - 5334	43	B-322
Thermostatic Steam Valves	23 Bldgs.	13,765	55,473	1.6	152	11	90,849	41,928	Heat/Cool Mech. - 1500	25	B-259
Automatic Chiller Condenser Tube Cleaning	Bldg. 2577 ✓	5,042	20,328	2.1	118	14	42,675	20,321	Heat/Cool Mech. - 1729	12	B-74
Boiler Fuel Conservation/ Oxygen Trim Control	Bldgs. 3902, 7008, 157, 858, 7294	38,860	290,468	1.3	100	19	294,800	-	-	31	B-279
Automatic Chiller Condenser Tube Cleaning	Bldg. 95 ✓	2,689	8,417	3.2	99	4	27,264	17,311	Heat/Cool Mech. - 736	12	B-68
Ceiling Fans	751 through 756	2,609	10,491	3.0	84	10	31,220	9,745	Electrician - 560	17	B-133
Automatic Chiller Condenser Tube Cleaning	Bldg. 3902 ✓	7,542	31,223	3.1	78	7	96,314	20,384	Heat/Cool Mech. - 867	12	B-80
De-Stratifiers	7250	425	1,707	3.5	71	9	5,972	3,792	Electrician - 113	21	B-228

*All figures are on a per unit basis.
N/A - Not Applicable.

TABLE 9
(Cont.)

Summary of Increment G Projects

Project	Location (s)	Energy Savings/Year MMBtu	Dollar Savings/Year	Payback Years	E/C	B/C	Contract Cost	In-House Cost		Reference Pages
								Material	Manhours	
Ceiling Fans	6992	317	\$1,275	3.5	671	59	\$4,441	\$1,239	Electrician - 88	17 B-149
Ceiling Fans	6990	317	1,275	3.5	71	9	4,441	1,239	Electrician - 88	17 B-156
Automatic Chiller Condenser Tube Cleaning	Bldg. 6774 ✓	3,025	12,197	3.7	71	9	42,675	20,321	Heat/Cool Mech. - 1729	12 B-92
De-Stratifiers	7251	439	1,761	3.6	70	9	6,304	4,002	Electrician - 119	21 B-222
De-Stratifiers	7252	250	1,005	3.6	69	9	3,650	2,317	Electrician - 69	21 B-234
De-Stratifiers	7285	290	1,166	3.7	68	9	4,296	2,728	Electrician - 81	21 B-240
Replacement of Incandescent Lighting with High Pressure Sodium	Bldg. 2270	378	2,275	2.8	60	6	6,277	3,189	Electrician - 48	11 B-41
Ceiling Fans	Barkley Elem. School	153	614	4.2	59	8	2,584	728	Electrician - 51	17 B-195
Ceiling Fans	Lincoln Elem. School	290	1,164	4.4	56	7	5,167	1,456	Electrician - 102	17 B-208
Ceiling Fans	2604	241	620	7.5	54	2	4,441	1,239	Electrician - 88	17 B-162
Ceiling Fans	Marshall Elem. School	137	550	4.7	53	7	2,584	728	Electrician - 51	17 B-202
Ceiling Fans	2270	168	673	5.0	50	6	3,385	472	Electrician - 92	17 B-168

*All figures are on a per unit basis.
N/A - Not Applicable.

TABLE 9
(Cont.)

Summary of Increment G Projects

Project	Location (s)	Energy Savings/Year		Dollar Savings/Year	Payback Years	E/C	B/C	Contract Cost	In-House Cost		Reference Pages
		MMBtu	MBtu						Material	Manhours	
Ceiling Fans	3932	78	7	\$ 314	6.1	41	5	\$1,919	\$409	Electrician - 45	17 B-182
Ceiling Fans	3610	72		288	6.7	37	5	1,919	409	Electrician - 45	17 B-189
Ceiling Fans	5702	153		610	6.9	37	5	4,185	1,301	Electrician - 75	17 B-175
Water Heating Heat Pumps	Per Unit Basis	33		95	9.3	37	2	882	784	Heat/Cool Mech. - 3	8 B-1
Electronic Ignition on Furnaces	1701 Units	10,036		40,646	7.3	34	4	295,736	153,579	Heat/Cool Mech. - 1701	42 B-314
Boiler Replacement	10 Bldgs.	11,624		98,484	3.8	31	7	375,832	241,686	Pipefitter - 2,220 Sheet Metal Worker - 2,270 Electrician - 1,135	23 B-248
Replacement of Incandescent Lighting with High Pressure Sodium	Bldg. 2604	408		3,072	4.8	28	4	14,743	6,967	Electrician - 140	11 B-40
Infrared Heating	5207	5,524		18,892	13.5	22	22	255,827	161,248	Heat/Cool Mech. - 10,094	15 B-107
Ceiling Fans	6145	65		259	11.9	21	3	3,080	650	Electrician - 72	17 B-141
Heat Reclaim From Condensing Units	Bldg. 2702	1,233.1		4,969	13.9	18	2	68,961	48,079	Heat/Cool Mech. - 441	10 B-8

*All figures are on a per unit basis.
N/A - Not Applicable.

TABLE 9
(Cont.)

Summary of Increment G Projects

Project	Location (s)	Energy Savings/Year MMBtu	Dollar Savings/Year	Payback Years	E/C	B/C	Contract Cost	In-House Cost		Reference Pages
								Material	Manhours	
Infrared Heating	751 through 756	2,789	\$9,538	22.5	13	1	\$214,151	\$130,393	Heat/Cool Mech. - 8,939	15 B-119
Infrared Heating	5123 & 5125	562	1,922	23.0	13	31	44,565	28,016	Heat/Cool Mech. - 1,766	15 B-113
Chiller Modulation	3902 & New Hospital	585	1,685	31.3	11	1	52,685	-	-	27 B-267
Infrared Heating	10 Buildings	715	3,873	38.9	5	1	150,514	93,255	Heat/Cool Mech. - 6,111	15 B-125
Lighting Reduction	6551	39,902	165,194	79.7	3	.3	13,171,200	-	-	30 B-273

*All figures are on a per unit basis.
N/A - Not Applicable.